

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

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IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Previously Presented): An electromagnetic wave detector comprising:

a stack of layers made of III-V semiconductor materials, a conduction band profile of said materials defining at least one quantum well, said quantum well having at least one first discrete energy level populated with electrons that are capable of passing to a second energy level under an absorption of an electromagnetic wave; and

means for counting said electrons in the second energy level,

wherein the stack of layers of semiconductor materials furthermore comprises a transfer barrier layer, and an electron storage layer separated from the quantum well by the transfer barrier layer, said electron storage layer includes a metastable level, and said transfer barrier layer includes a component having a concentration that varies linearly, decreasing in a direction from said quantum well to said electron storage layer, and

wherein a thickness of the transfer barrier layer is at least an order of magnitude greater than a thickness of the quantum well, a lowest energy level of a conduction band of the transfer barrier layer is greater than energy levels of the quantum well and the electron storage layer, and the conduction band profile of the stack of layers of semiconductor materials decreases from the quantum well to the electron storage layer so as to further a flow of electrons from the second energy level to the electron storage layer.

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

Claim 2 (Previously Presented): An electromagnetic wave detector according to claim 1, wherein the stack of layers made of III-V semiconductor materials furthermore comprises:

- a first barrier layer; and
- a third barrier layer, both of the first and third layers being made of semiconductor materials such that a lowest energy level of a conduction band of said both layers is respectively greater than a lowest energy level of the conduction band of the quantum well and of the electron storage layer.

Claim 3 (Previously Presented): An electromagnetic wave detector according to claim 1, wherein a decreasing profile of the lowest energy level of the conduction band of the transfer barrier layer is obtained with a semiconductor alloy having a composition varying from the quantum well to the electron storage layer.

Claims 4-5 (Cancelled).

Claim 6 (Previously Presented): An electromagnetic wave detector according to claim 1, wherein the counting means comprises:

- a first ohmic contact; and
- a second ohmic contact, both of the first and second ohmic contacts being located at the electron storage layer so as to carry out a measurement of photocurrent in a plane of the storage layer.

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

Claim 7 (Currently Amended): An electromagnetic wave detector according to claim
[[5]] 1, further comprising the following stack of layers of semiconductor materials, starting
from a surface of a semiconductor substrate:

a first barrier layer;

a quantum well;

a second barrier layer that is a transfer barrier layer;

an electron storage layer;

a third barrier layer;

the first and second ohmic contacts extending from the third barrier layer up to the
electron storage layer.

Claim 8 (Withdrawn): An electromagnetic wave detector according to claim 6,
comprising the following stack of layers of semiconductor materials, starting from a surface of
a semiconductor substrate:

a third barrier layer;

an electron storage layer;

a second barrier layer that is a transfer barrier layer;

an electron storage layer;

a first barrier layer;

and a mesa defined in:

the transfer barrier layer;

the quantum well;

the first barrier layer;

the first and second ohmic contacts being located on either side of the mesa.

Claim 9 (Withdrawn): An electromagnetic wave detector according to claim 1, wherein the means for counting electrons in the second energy level comprise a first ohmic contact and a second ohmic contact located respectively in the quantum well and in the electron storage layer so as to carry out a photovoltaic reading of a voltage set up between electrons of the quantum well and electrons of the storage well.

Claim 10 (Withdrawn): An electromagnetic wave detector according to claim 9, comprising the following stack of semiconductor materials starting from semiconductor substrate:

- a first barrier layer;
- a quantum well;
- a second barrier layer that is a transfer barrier layer;
- an electron storage layer;
- a third barrier layer;

and an etching up to the level of the transfer barrier layer so as to make the first ohmic contact extending up to the quantum well and the second ohmic contact extending up to the electron storage layer.

Claim 11 (Previously Presented): An electromagnetic wave detector according to claim 1, further comprising means for resetting the flow of the electrons in the storage layer.

Claim 12 (Original): An electromagnetic wave detector according to claim 6, comprising third and fourth contacts located on either side of the stack of layers of semiconductor materials.

Claim 13 (Previously Presented): An electromagnetic wave detector comprising:
a stack of layers made of III-V semiconductor materials, a conduction band profile of said materials defining at least one quantum well, said quantum well having at least one first discrete energy level populated with electrons that are capable of passing to a second energy level under an absorption of an electromagnetic wave; and
a counting unit configured to count said electrons in the second energy level,
wherein the stack of layers of semiconductor materials furthermore comprises a transfer barrier layer, and an electron storage layer separated from the quantum well by the transfer barrier layer,
wherein said electron storage layer includes a metastable level, said counting unit includes two electrodes in direct contact with said electron storage layer, and said two electrodes are separated from said quantum well, and
wherein a thickness of the transfer barrier layer is at least an order of magnitude greater than a thickness of the quantum well, a lowest energy level of a conduction band of the transfer barrier layer is greater than energy levels of the quantum well and the electron storage layer, and

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

the conduction band profile of the stack of layers of semiconductor materials decreases from the quantum well to the electron storage layer so as to further a flow of electrons from the second energy level to the electron storage layer.

Claim 14 (Previously Presented): An electromagnetic wave detector according to claim 13, wherein the stack of layers made of III-V semiconductor materials furthermore comprises:
a first barrier layer; and
a third barrier layer, both of the first and third layers being made of semiconductor materials such that a lowest energy level of a conduction band of both said layers is respectively greater than a lowest energy level of the conduction band of the quantum well and of the electron storage layer.

Claim 15 (Previously Presented): An electromagnetic wave detector according to claim 13, wherein a decreasing profile of the lowest energy level of the conduction band of the transfer barrier layer is obtained with a semiconductor alloy having a composition varying from the quantum well to the electron storage layer.

Claim 16 (Withdrawn): An electromagnetic wave detector according to claim 13, wherein the decreasing profile of the lowest energy level of the conduction band of the transfer barrier layer is obtained by a presence, in the stack of layers made of semiconductor materials, of a piezoelectric semiconductor material creating a natural electrical field.

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

Claim 17 (Withdrawn): An electromagnetic wave detector according to claim 13, wherein the stack of layers made of semiconductor materials comprises a first layer and a second layer of doped semiconductor materials on either side of the unit constituted by the electron storage layer/transfer barrier/quantum well so as to enable a creation of an electric field responsible for the decreasing profile of the lowest energy level of the conduction band of the transfer barrier layer.

Claim 18 (Previously Presented): An electromagnetic wave detector according to claim 13, wherein the counting unit is configured to carry out a measurement of a photocurrent in a plane of the electron storage layer.

Claim 19 (Withdrawn): An electromagnetic wave detector according to claim 17, further comprising the following stack of layers of semiconductor materials, starting from a surface of a semiconductor substrate:

- a first barrier layer;

- a quantum well;

- a second barrier layer that is a transfer barrier layer;

- an electron storage layer;

- a third barrier layer;

the first and second ohmic contacts extending from the third barrier layer up to the electron storage layer.

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

Claim 20 (Withdrawn): An electromagnetic wave detector according to claim 18,
comprising the following stack of layers of semiconductor materials, starting from a surface of
a semiconductor substrate:

- a third barrier layer;
- an electron storage layer;
- a second barrier layer that is a transfer barrier layer;
- an electron storage layer;
- a first barrier layer;
- and a mesa defined in:
 - the transfer barrier layer;
 - the quantum well;
 - the first barrier layer;
- the first and second ohmic contacts being located on either side of the mesa.

Claim 21 (Withdrawn): An electromagnetic wave detector according to claim 13,
wherein the counting unit comprises:

- a first ohmic contact; and
- a second ohmic contact, both of the first and second ohmic contacts being located
respectively in the quantum well and in the electron storage layer so as to carry out a
photovoltaic reading of a voltage set up between electrons of the quantum well and electrons
of the storage well.

Application No. 09/328,391
Reply to Advisory Action of April 20, 2004,
and further to the Request for Reconsideration filed March 31, 2004

Claim 22 (Withdrawn): An electromagnetic wave detector according to claim 21, comprising the following stack of semiconductor materials starting from semiconductor substrate:

a first barrier layer;

a quantum well;

a second barrier layer that is a transfer barrier layer;

an electron storage layer;

a third barrier layer;

and an etching up to the level of the transfer barrier layer so as to make the first ohmic contact extending up to the quantum well and the second ohmic contact extending up the electron storage layer.

Claim 23 (Previously Presented): An electromagnetic wave detector according to claim 13, further comprising a resetting unit configured to reset the flow of the electrons in the storage layer.

Claim 24 (Previously Presented): An electromagnetic wave detector according to claim 13, comprising third and fourth contacts located on either side of the stack of layers of semiconductor materials.